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(71) Applicant
Stearns McGee Inc

(Incorporated in the USA - Texas)

7811 West View, Houston, Texas 77055, United States of America

(72) Inventors
Kenneth W Stearns
John K McGee

(74) Agent and/or Address for Service
Kilburn and Strode
30 John Street, London, WC1N 2DD, United Kingdom

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(54) Treadmill

(57) A treadmill has a belt system carried by a platform structure 16. The platform structure is pivotally mounted at its rear end to a base structure. The platform is supported at its forward end by a shock absorber/spring system 32, 36 which provides a dampened resilient response of the belt and platform when a person's foot lands during running or walking. Carrying the belt system by the platform structure enables the endless belt of the belt system to be maintained closely above the platform even when a runner's foot lands on it with heavy impact. The support of the platform immediately below the belt eliminates lateral slack in the belt, which could possibly result in injury to a walker or runner due to an uneven landing surface.

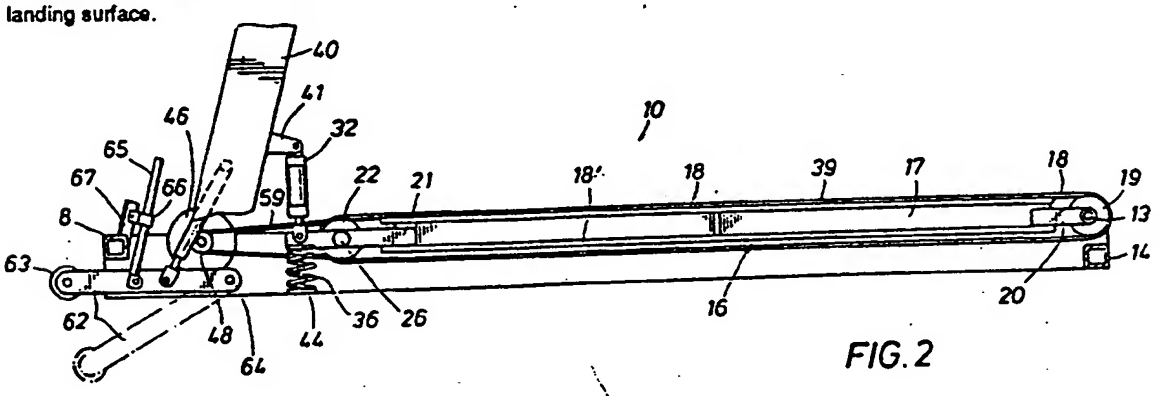

FIG. 2

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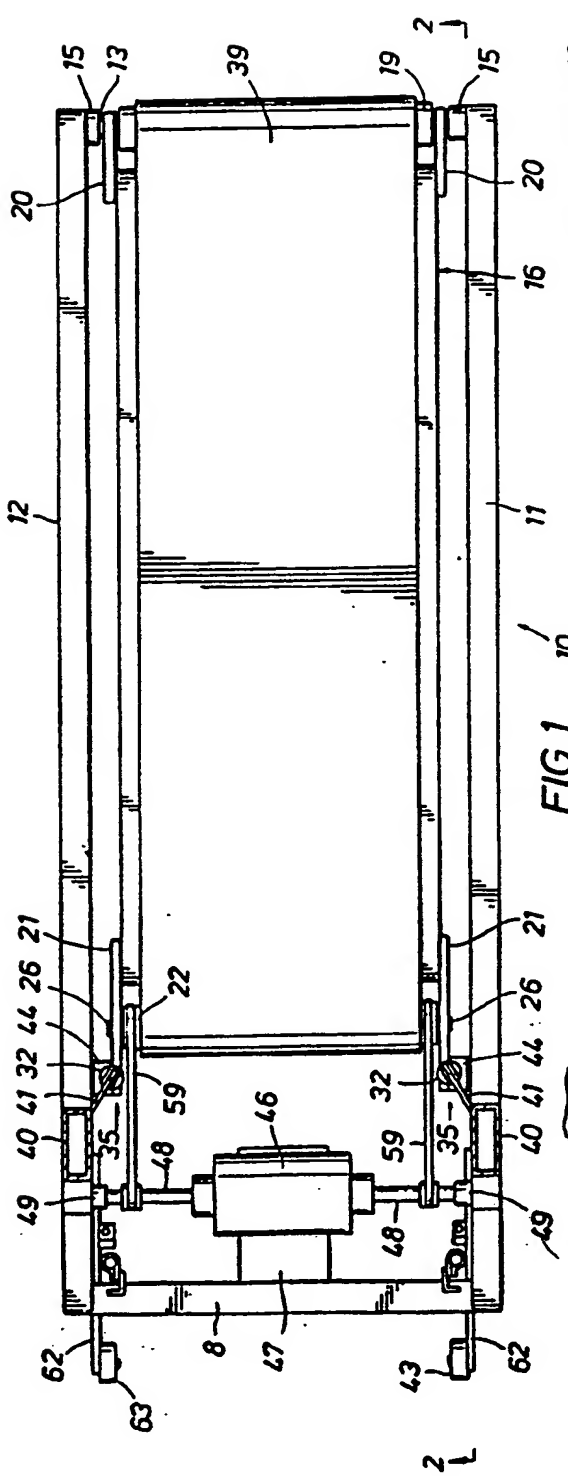

FIG.1

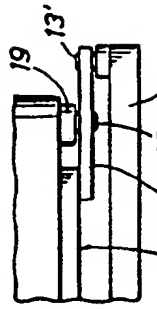

FIG.1A

FIG.2

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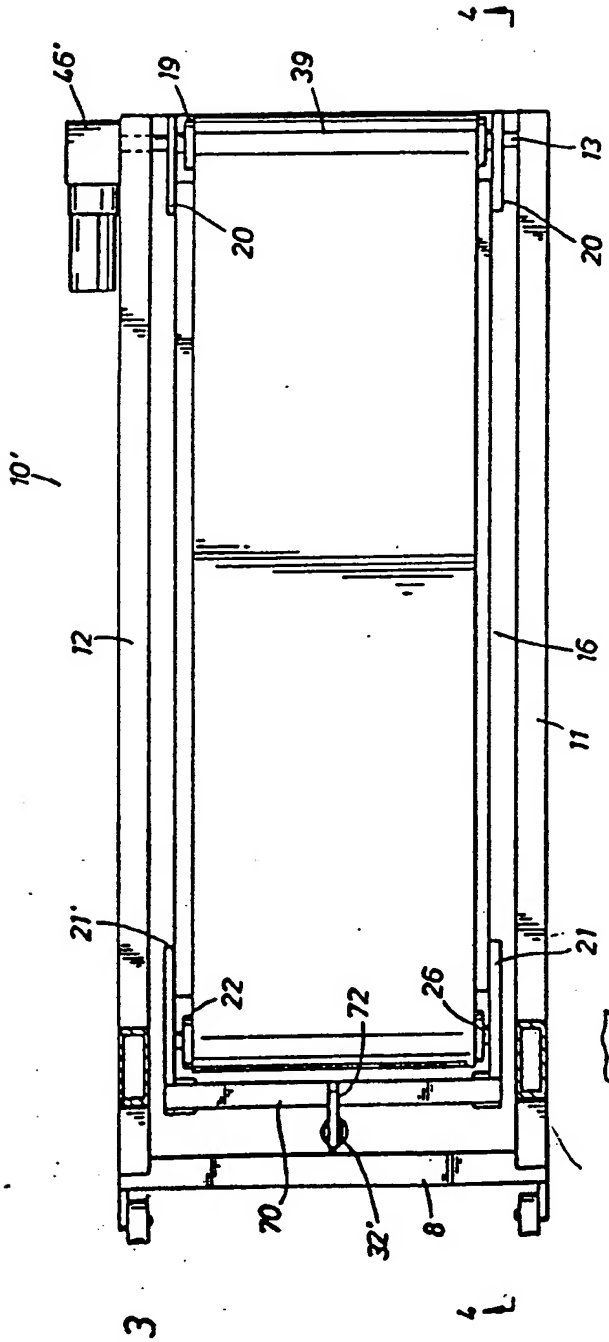

FIG.3

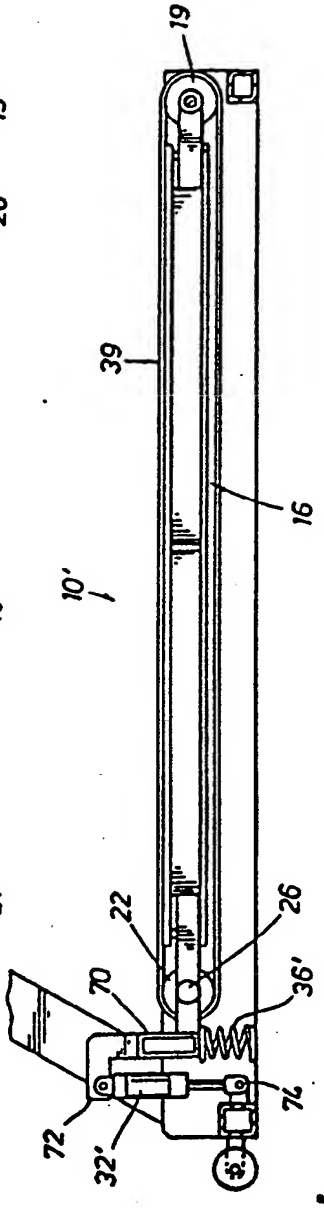

FIG.4

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"TREADMILL"

This invention relates in general to treadmills and in particular to an improved shock absorbing treadmill which provides in use reduced landing forces to a runner's foot while simultaneously providing a substantially flat, stable running surface.

The art has provided treadmills in response to demand of walkers, joggers and runners and the medical profession for a device which may be used, especially indoors, for exercise where outdoor walking, jogging or running is not enjoyable or practical. A problem with running or jogging as an exercise to strengthen the cardiovascular system relates to the possibility of impact injury to feet, ankles and knees caused by the force of the runner's foot striking an unyielding surface, such as street pavement. Prior treadmill designs have recognized this problem and have attempted to solve it in a number of ways. For example, U.S. Patent 4,614,337 of Schomenberger discloses a treadmill with a flat top surface covered with a resilient surface such as foam rubber, carpeting or the like. Another example is U.S. Patent 4,548,405 to Lee et al which discloses a trampoline-like top surface for a treadmill.

U.S. Patent 4,350,336 to Hanford provides a treadmill having a frame to which rollers are attached which carry an endless tread belt. The belt moves above a platform disposed beneath the running portion of the belt. The platform is supported by longitudinal platform rails which are supported at one end by a lateral frame member which is secured to the frame.

The platform is supported at its other end by shock absorbing members attached to the longitudinal rails. The shock absorbing member may be moved longitudinally with respect to the frame. The shock absorbing member absorbs shock directly from the platform as a runner exercises on the treadmill belt above. The platform flexes longitudinally as it pivots at one end and is shock absorbingly supported at its other end.

Although an admirable improvement in the art of shock absorbing treadmills, the Hanford treadmill does not provide an adequately stable running surface. The platform is shock absorbingly supported, but the endless tread belt is not. The belt rollers are both supported directly by the frame. As a result, the belt runs over the platform with sufficient slack in it to allow the platform beneath it to move downwardly in response to the impact of a runner's foot. The slack in the belt can cause an uneven lateral surface for succeeding foot landings, possibly leading to twisted ankles, knees, etc.

The invention aims to provide a stable, flat running surface for a treadmill having a shock absorbing means to cushion the impact of a runner's foot.

The invention also aims to provide a treadmill having an endless belt which is firmly supported by a platform, and yet the platform and the endless belt and its drive means are shock absorbingly supported.

According to the present invention an exercise treadmill includes a belt system including forward and rear rollers and an endless belt placed about such rollers. The belt has an upwardly exposed operative section adapted for running or walking. A belt support

platform structure having forward and rear ends provides support for the belt system. The platform structure partially underlies the operative section of the belt and carries the forward roller of the belt system. The rear end of the platform structure is pivotally supported to a base structure near its rear end. The rear roller of the belt system is mounted near the rear end of the platform such that it is free to rotate with the movement of the endless belt. The mounting of the rear roller is preferably to the base structure, but alternatively, may be carried by the platform structure near its end. The platform structure is supported at its forward end by a shock absorber/spring system, preferably linked to the base structure, or alternatively, simply to the ground or floor on which the treadmill is placed. The shock absorber/spring support of the platform structure reduces impact forces on a runner's foot. Such impact force reduction is a result of the downward movement of the platform after the runner's foot strikes the belt above the platform. The platform's downward movement, opposed by the spring(s) of the system, is dampened by the shock absorber(s) of the system. As the runner strides to take another step, the platform, and the belt system carried by it, returns to a non-loaded position. Because of the close proximity of the operative section of the endless belt to the platform, there is no slack or sagging of the belt which could cause a runner's foot, ankle or leg to twist upon landing of his foot on the belt.

The invention may be put into practice in various ways and two specific embodiments will be described by way of example with reference to the accompanying

drawings in which like numerals indicate like parts and in which:

Figure 1 is a plan view of a treadmill according to the invention which incorporates a shock absorber/spring system;

Figure 1A is a partial plan view of the rear of the treadmill which illustrates a modification in which the rear of the treadmill is mounted to or carried by a portion of the platform structure which is pivotally mounted on the base of the treadmill;

Figure 2 is a sectional view taken along lines 2-2 of Figure 1 which further illustrates details of construction of the treadmill with a shock absorber/spring system;

Figure 3 is a plan view of an alternative treadmill according to the invention incorporating a modified shock absorber/spring system and a treadmill drive system connected to its rear roller; and

Figure 4 is a sectional view taken along the line 4-4 of Figure 3.

The treadmill 10 of Figures 1 and 2 includes a support base having a pair of spaced longitudinal rails 11 and 12. The rails 11 and 12 extend the full length of the apparatus. They are normally placed horizontally on the floor although one end of them may be elevated as will be described below. The rails 11 and 12 are joined by cross support members 8 and 14 and others as appropriate.

The longitudinal rails 11, 12 have a pair of inwardly directed shaft bearing members 15 in which the ends of a shaft 13 are placed and are free to turn. Rear connection members 20, pivotally connected to the shaft 13, are rigidly connected to side members 17 of a

platform structure 16. A rear roller 19 is disposed about the shaft 13 and rotates with it with respect to the base.

The platform structure 16 is generally rectangular in shape, constructed of lightweight material, and preferably includes a pair of longitudinal reinforcing side members 17 and rectangular upper and lower decking members 18, 18'.

Forward connection members 21, rigidly connected to the side members 17 of the platform structure 16, carry a shaft 26 to which a forward roller 22 is connected. The roller 22 and the shaft 26 are free to rotate with respect to the connection members 21 and the platform structure 16.

An endless belt 39 is placed about the rollers 22 and 19 and has sufficient longitudinal tension to create negligible vertical slack between the longitudinally spaced rollers. The underside of the belt 39 is constructed to pass or slide freely over the upper side of the upper decking member 18.

The platform structure 16, and the treadmill system (including rollers 22 and 19 and belt 39) are resiliently supported at the forward end by a shock absorber/spring system 35 in the plan view of Figure 1. Figure 2 shows the construction of such system 35 as including on both lateral sides, springs 36 secured at their top ends to the forward connection member 21 and at their bottom ends to the longitudinal rails 11 and 12 respectively by means of plates 44. The base, including the rails 11, 12 is of course placed on the ground or floor. Shock absorbers or dampers 32 are connected between the forward connection members 21 and vertical members 40, which in turn are connected to the

support base longitudinal rails 11 and 12. Links 41 connect the shock absorbers 32 to the vertical members 40. The vertical members 40 may also support a control panel, hand rails and the like (not illustrated).

The shock absorbers or dampers 32 introduce a frictional constraint K proportional to the velocity of the mass that is free to move vertically; in this case, the vertically movable part is the platform structure 16, and at least part of the belt system (belt 39 and roller 22). The platform structure 16 pivots about the rear shaft 13. The shock absorber 32 in the preferred embodiment of the invention is constructed to offer no resistance to downward movement of the structure 16 for the first one-half inch (1.25 cms) of travel and to introduce frictional constraint proportional to velocity thereafter.

A motor 46 is supported on the cross support member 8 by a bracket 47 and includes two coaxial output shafts 48 journaled in bearings 49 secured to the support base longitudinal rails 11 and 12. Belts 59 are placed about sheaves on the motor output shafts 48 and on the forward roller shaft 26 to drive the roller 22 and the endless belt 39.

The forward end of the treadmill 10 may be elevated by pivot legs 62 which may be pivoted about pins 64 to cause the support base to be horizontal with the ground or floor or cause the forward end to be raised. The phantom line illustration of pivot leg 62 (see Figure 2) illustrates that it can be pivoted downwardly with respect to point 64, thereby raising the forward end of the treadmill, causing the user of it to be running, walking, etc. on an upward grade. Support rods 65, attached to the pivot legs 62, may be

clamped by clamps 66 at different positions. The clamps 66 are connected to cross support member 8 by links 67. Accordingly, the support rods 65 may hold the pivot legs 62 at a desired angular position. Wheels 63, affixed to the ends of the legs 62, aid in moving the treadmill along the floor or ground.

The embodiment of the invention illustrated in Figures 1 and 2 is used as an exercise treadmill where a runner operates the motor 46 to cause the endless belt 39 to move across the upper surface of decking 18 of platform structure 16. With each step, the runner lands on endless belt 39 and decking 18 which imparts a downward force to the forward connection member 21 and to the springs 36 and shock absorbers 32 as the forward roller 22, and the platform structure 16 pivot about the shaft 13. The spring 36 opposes the downward force proportional to the downward distance of movement of the forward end of the platform structure 16. The shock absorber 32 opposes downward force proportional to the velocity at which the mass is moving. The mass itself opposes the downward force proportional to the acceleration at which it is moving. By proper selection of the mass of the system, the spring constant of the spring 36, and the friction constant of the shock absorber 32, a damped response of the treadmill can be achieved in response to the landing force of a runner's foot on the belt 39 and the platform structure 16. Of course, the treadmill system returns to its original position, with a damped response in the opposite direction when the runner takes another stride.

The result is less impact force on the runner's feet, ankles and limbs, because on landing on the

treadmill, his foot meets a yielding surface which moves downwardly with a damped response. In other words, his foot decelerates over a longer time period-determined by the response time constant of the mass, spring constant, and friction constant of the shock absorbers. This longer time period is in contrast to the situation where the runner's foot lands on an unyielding surface, such as concrete pavement, where the deceleration of the runner's foot is much shorter and the shock force of impact is imparted to his foot, ankle and leg.

An advantageous feature of the invention is that the decking 18 of the platform structure 16 is maintained in close proximity to the belt while the belt moves or slides freely above the decking 18. This proximity of the belt 39 and the decking 18 prevents the belt 39 from sagging or yielding as the runner's foot lands on the belt 39 and the decking 18 below. A stable running surface, that is, a taut belt with the decking 18 immediately below it, presents a laterally stable running surface which should assist avoidance of turned or twisted feet, ankles or knees of the runner.

An alternative embodiment of the invention incorporating a shock absorbing system is illustrated in Figures 3 and 4. In this embodiment, the forward connection members 21' support shaft 26 of forward roller 22 as in the embodiment of Figure 1, but members 21' are each connected to a cross-member 70 which is supported by a single spring 36' (which may be supported by the floor or a connecting member (not shown) attached to rails 11 or 12. A single shock absorber or damper 32' may be connected to the cross-member 70 via a linkage 72 and to the base cross-member

8 via a linkage 74. The endless belt 39 may be driven by a motor 46' mounted at the rear, the output shaft of which drives the shaft 13 to which the rear roller 19 is rigidly attached.

The description of preferred embodiments of the invention described above should be viewed as illustrative of the invention and not limitative. Structural changes from the treadmills illustrated and described above may occur to one skilled in the treadmill art. For example, the support base may be modified such that the longitudinal rails 11, 12 are split into forward and rear sections to provide forward and rear support for the platform structure 16 without extending the entire longitudinal distance of the treadmill. The rear roller of the belt system may be carried by the rear platform structure rather than mounted on the support base. As illustrated in Figure 1A, the roller 19 may be mounted or carried by the shaft 13, which may rotate in a member 20' attached to the platform structure 16. The member 20' is pivotally supported by the shaft 13, which is connected to the base 11. The spring and shock absorber of the front mounting for the platform structure could engage directly to the floor or ground on which the treadmill is placed. Gear drives could be used to drive either the front or rear rollers rather than the preferred belts as illustrated. Accordingly, the only limitations to the invention are incorporated in the claims which follow.

CLAIMS

1. An exercise traedmill, comprising:

a base;

a belt system including forward and rear rollers and an endless belt placed about the said rollers, the said belt having an upwardly exposed operative section;

a belt support platform structure having forward and rear ends, the said platform structure at least partially underlying the said operative section of the said belt and carrying the said forward and rear rollers of the said belt system;

supporting means for pivotally supporting the said platform structure to the said base near the rear end; and

shock absorbing platform support means disposed between the said forward end of the said platform structure and the base base or the surface on which the base rests for supporting the said platform structure and the said belt system and adapted to reduce impact forces on a runner running on the said operative section of the said belt.

2. An exercise treadmill, comprising:

a belt;

a belt system including forward and rear rollers and an endless belt placed about the said rollers, the said belt having an upwardly exposed operative section;

a belt support platform structure having forward and rear ends, the said platform structure at least partially underlying the said operative section of the said belt and carrying the said forward roller of the

said belt system;

supporting means for pivotally supporting the said platform structure to the said base near the rear end;

means for mounting the said rear roller of the said belt system to the said base near the rear end of the said platform structure; and

shock absorbing platform support means disposed between the said forward end of the said platform structure and the said base or the surface on which the base rests for supporting the said platform structure and the said belt system and adapted to reduce impact forces on a runner running on the said operative section of the said belt.

3. A treadmill as claimed in Claim 1 or Claim 2 in which the said platform support means includes

spring disposed means between the said base or the surface on which the base rests and the said forward end of the said platform structure; and

damping means disposed between the said base and the said forward end of the said platform structure.

4. A treadmill as claimed in Claim 1, 2 or 3 in which the said platform support means includes on each lateral side of the forward end of the said platform structure a spring disposed between the said base or the surface on which the base rests and the said platform and damping means disposed between the said base and the said platform structure.

5. A treadmill as claimed in any one of Claims 1 to 4 in which the said platform structure includes:

a centre section having forward and rear ends and

decking adapted for underlying the said operative section of the said belt;

a pair of rear connection members each rigidly connected to the rear end of the said centre section and each pivotally connected to the said base; and

a pair of forward connection members, each rigidly connected to the forward end of the said centre section.

6. A treadmill as claimed in Claim 5, in which the said forward roller of the said belt system is carried by the said pair of forward connection members.

7. A treadmill as claimed in any one of Claims 1 to 6 in which the said means for mounting the said rear roller of the said belt system is secured to the said base.

8. A treadmill as claimed in any one of Claims 1 to 7 in which the said platform support means includes a spring and a damping means connected between each of the said pair of the said forward connections and the said base.

9. A treadmill as claimed in any one of Claims 1 to 8 further comprising powered means for rotating the said forward roller.

10. A treadmill as claimed in any one of Claims 1 to 7 which further comprises a cross-member connected between the said pair of forward connection members, and in which the said platform support means includes a spring and a damping means each connected between the

said cross-member and the said base, or the surface on which the base rests.

11. A treadmill as claimed in Claim 10 further comprising powered means for rotating the said rear roller.

12. A treadmill as claimed in Claim 1 substantially as specifically described herein with reference to Figures 1 and 2 or Figures 1, 1A and 2 or Figures 3 and 4.

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